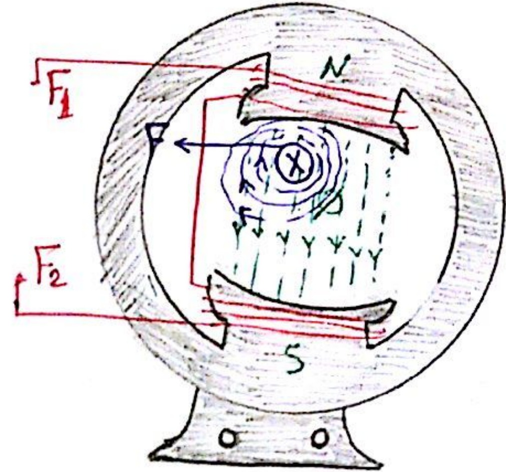
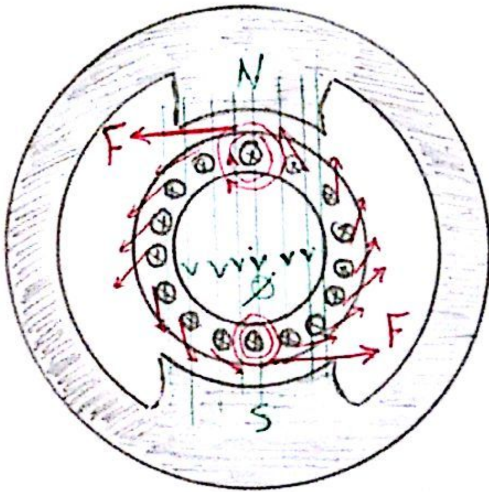
ch 2

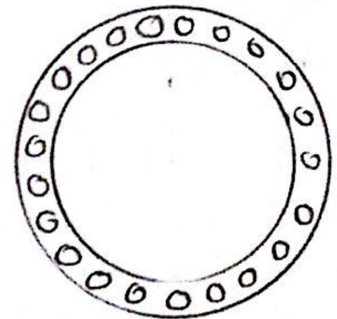
D.C Motors

P_{in} = electrical input power = V I

P_{out} = Mechanical power out put = T . w



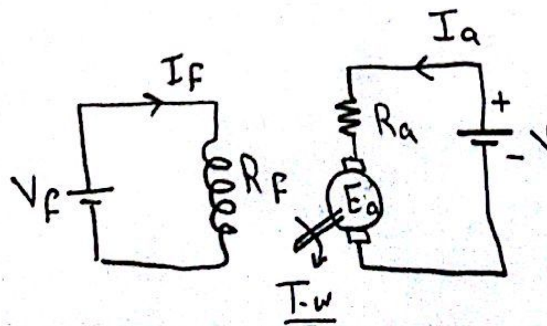




لابد أن يتوفر ثلاث أشياء لكي يعمل الموتور .

- الفيض مغناطيسي .
- تيار سار داخل ملفات الـ rotor .
- موصل





(b)

$$P_{in} = V I$$

$$V = E_b + I_a R_a$$

قوة دافعة عكسية مستحدثة → $E_b = V - I_a R_a$ → motor

$E_a = V + I_a R_a$ → Gen

$$V I_a = E_b I_a + I_a^2 R_a$$

$V I_a$ → P_{in}

$E_b I_a$ → P_a
- armature power.
- electromech. power.
- developed power.

$I_a^2 R_a$ → armature cupper losses.

$$P_a = E_b I_a$$

$$P_a = E_a I_a = \frac{P}{A} \phi Z \frac{N}{60} \cdot I_a$$

T_a → Armature Torque

$$T_a = \frac{P_a}{w}$$

$$w = 2\pi \frac{N}{60}$$

$$T_a = \frac{P_a}{2\pi \frac{N}{60}} = \frac{P/A \, \phi Z \frac{N}{60} * I_a}{2\pi \frac{N}{60}}$$

* $T_a = \frac{P/A \, \phi Z}{2\pi} I_a$

* $T_a = K_T \phi I_a$

Type of Torque in the motor

[C]

$T_a = K_T \phi I_a$ → Armature Torquie.

$T_{sh} = T_{out} = T_L$ → Load Torque
output Torque

T_F = Friction Torque
(قيمة ثابتة مادام (N) ← ثابتة)

$$\boxed{T_a = T_L + T_F}$$

at No load → $T_L = 0$

$T_{a_o} = T_F$ (No load)

$T_a = K_T \phi I_a$

$T_a \propto I_a$

$$\boxed{T_{a_o} \propto I_{a_o}}$$

$P_{in_o} = I_{a_o} \cdot V$

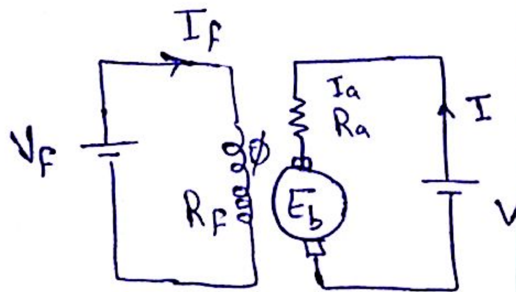
$P_{out} = 0$

$\eta = 0$

d

Types of D.c Motors

separately excited



$$I_f = \frac{V_f}{R_f}$$

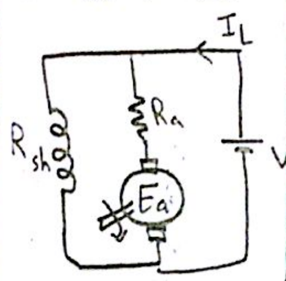
$$I_f \propto \phi$$

$$V = E_b + I_a R_a + \Delta V_b$$

$$T_a = K_T \phi I_a$$

self exated

shunt Motor



$$V = E_b + I_a R_a + \Delta V_b$$

$$I_L = I_a + I_{sh}$$

$$I_{sh} = \frac{V}{R_{sh}}$$

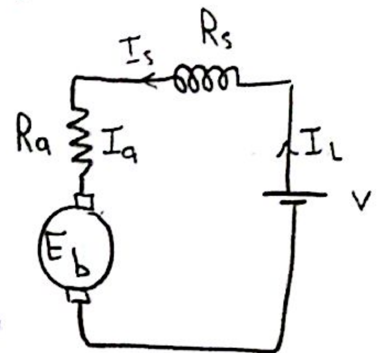
$$\phi \propto I_{sh}$$

$$\phi = const$$

$$T = k \phi I_a$$

$$T \propto I_a$$

series



$$I_L = I_s = I_a$$

$$V = E_b + I_a (R_a + R_s) + \Delta V_b$$

$$T = K_T \phi I_a$$

$$\phi \propto I_a$$

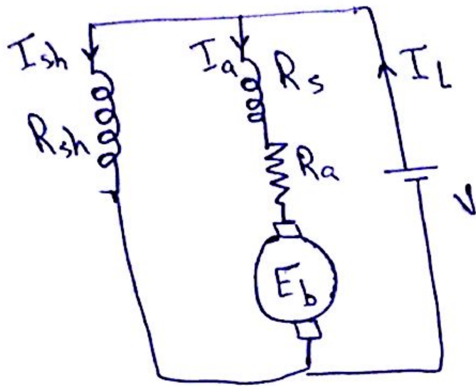
$$T_a \propto I_a^2$$

Compound

- shurt
- Long

Compound D.C motor

Long



$$\phi = \phi_{sh} \pm \phi_{se}$$

$\phi_{sh} \rightarrow I_{sh}$, $\phi_{se} \rightarrow I_a$

$$I_L = I_a + I_{sh}$$

$$I_{sh} = \frac{V}{R_{sh}}$$

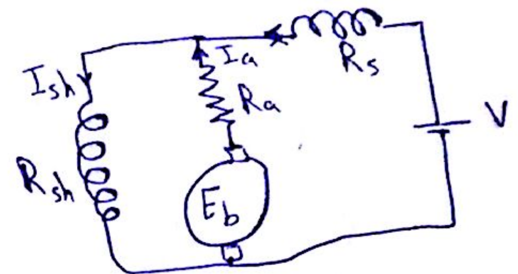
$$V = E_b + I_a(R_a + R_s) + \Delta V_b$$

$$T = K_T \phi I_a$$

$$T = K_T (\phi_{sh} \pm \phi_s) I_a$$

Short

$I_L = I_s$



$$V = E_b + I_a R_a + I_L R_s + \Delta V_b$$

$$I_L = I_a + I_{sh}$$

$$I_{sh} = \frac{V - I_L R_s}{R_{sh}}$$

$$T_a = K(\phi_{sh} \pm \phi_s) I_a$$

$$T_a = K_1 I_a \pm K_2 I_L \cdot I_a$$

Scanned by CamScanner

F

Torque speed equation

$$E_b = \frac{P}{A} \phi Z \frac{N}{60}$$

$$V = E_b + I_a R_a \longrightarrow \text{shunt.}$$

$$E_b = V - I_a R_a$$

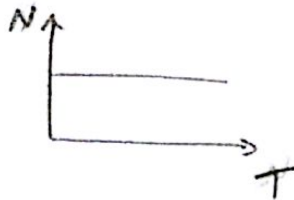
$$\frac{P}{A} \phi Z \frac{N}{60} = V - I_a R_a$$

ثابت

$$N = \frac{V - I_a R_a}{K \phi}$$

shunt

متغير يعتمد على I_a



For shunt motor

$$\phi = \text{const.}$$

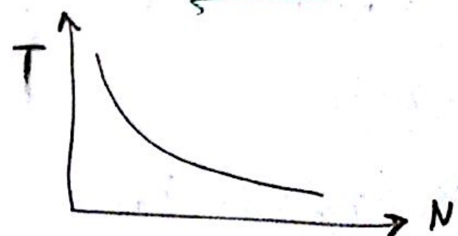
$$N \propto V - I_a R_a$$

For series

$$N = \frac{V - I_a (R_a + R_s)}{K \phi}$$

$$\phi \propto I_a$$

$$N \propto \frac{V - I_a (R_a + R_s)}{I_a}$$



$$\%\text{Speed Regulation} = \frac{N_{n.L} - N_{F.L}}{N_{F.L}} * 100$$

$N_{n.L}$: No load speed

$N_{F.L}$: Full load speed